

Dealing with wicked problems, in messy contexts, through prototyping

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Abstract: This paper explores how designers' core competencies relate to the emerging paradigmatic shift in design practice, and provides suggestions for design education. The shift is due to the increased interest from design in engaging with social and political contexts and issues the last fifteen years. Designers have several core competencies and in this paper prototyping and thereby the capacity to work with wicked problems are explored. More explicitly, we suggest that designers can design relevant propositions with the help of successive prototyping. Tightly integrating designing propositions with problem setting is necessary when dealing with wicked problems. This works well when designers deal with signs and things. However, in order to deal with increasingly complex contexts, we suggest that design students should get more relevant experience of prototyping in complex contexts and improved reflection by making use of theories from STS in order to deal with these complex contexts.

Keywords: design, prototyping, wicked problems, problem-setting, messy contexts

1. Introduction

How to see, where to see from? What limits the vision? What to see for? Whom to see with? Who gets to have more than one point of view? Who gets blinded? Who wears blinders? Who interprets the field? What other sensory powers do we want to cultivate besides the vision? (Haraway 1988: 587)

During the last decennia it has become obvious that design has always been engaged in developing products, as well as part of social processes, public services, and different forms for cooperation. Designers are increasingly working with activities that mostly have societal implications. Both as employees in public organisations such as Swedish Social Insurance Authority (Försäkringskassan), public policy labs such as the UK based Policy Lab, Danish Design Lab, or as consultants commissioned to do design projects with various public or private bodies. Design as a field of knowledge is in constant development and it is crucial to understand design in this larger perspective.

Accordingly, there is an emerging paradigmatic shift in design education, addressing shifts noticed in changing design practice. Adopting Buchanan's four orders of design (1992, 2001, 2015) the transition between first-second (signs and things) and the third-fourth (interactions and systems) orders can be seen as an illustration of this paradigmatic shift. Recent years several new Master's programmes have been developed with directions that clearly indicate a shift towards design with emphasis on the third and fourth orders of design: transformation design, transition design, transdisciplinary design, service design, design for citizenship, environmental design, integrative design, etc..

Given that this transition is already happening we take for granted that designers will be engaged in an assembly of people and things in the endeavour of creating propositions for highly complex settings. In these contexts designers are:

- not primarily working on their own,
- working in contexts with no or little prior knowledge of design as profession,
- working with issues and concerns that are of political character,
- working in contexts where they have no or little prior knowledge of the knowledge areas and processes involved, and
- not having a clear role or assignment.

Still, design as an approach, method, and profession is being forwarded as a strong contributor to the collaborative development of our society (see e.g. Kimbell 2014, Manzini 2015, Wilson & Zamberlain 2015, Mulgan 2014, Wetter-Edman 2014). A question asked is how do designers' core competencies stand in relation to these contemporary challenges.

This paper explores potential implications for design education on artistic foundation; addressing and critically reflecting on designers' core competencies and ways of working. With specific attention to designers' capability to despite the wickedness of problems with endless amount of possibilities and constraints, contradicting desires and values, still with the help of prototypes, create relevant proposals in a limited amount of time. These prototypes need to be negotiated and debated with the help of stakeholders and their situated knowledges.

We see designerly core competencies as competencies that are used throughout the four orders, although they will act out differently. What these core competencies are have been suggested and discussed by several researchers, and there are different ways of categorising and understanding these. In short designers' core competencies involve problem-setting, negotiation, collaborations, decisions and above all, reflections, all through well articulated and reflective, materialisations. All these competencies are included in the prototyping activities that we will focus on in this paper.

Despite the apparent focus on the exploration of proposals, the solution, the most important competence of design is problem-setting (Schön 1983, Dorst & Cross 2001), to question the reasons, aims set out, and learn more about the opportunities, needs, desires and constraints that are engaged in the situation.

The contexts we are addressing can be seen as complex in the sense that the results of some action will be unpredictable, which causes uncertainty. These contexts could also be presented as messy (Law 2003, 2004).

In the following we first present our understanding and position of design education on artistic foundation, secondly Buchanan's four orders of design related to prototyping, thirdly complexity, wicked problems, problem-setting and a Science and Technology Studies (STS) informed understanding of messiness.

Background

Our starting position is a design education on artistic foundation. Specifically where designers educated with an artistic foundation are engaged with the purpose to initiate some kind of transformation. This implies, among other things, high emphasis on the individual's prior knowledge, experiences, materializations, preferences and a respect and encouragement on that the student conducts work that will not be the same as if someone else would do it. In an arts based design education lived experiences and knowledge connected to these are of great importance. These designers will, of course, also have core competencies that are similar to other designers trained on artistic foundation.

The authors of this paper have during ten months conducted an inquiry into current and future design educations through conversations and workshops with design practitioners and design academics, as well as study visits to several prominent design schools. These activities serve as inspiration and directions for our thinking rather than as empirical material.

From these workshops, visits and meetings certain issues re-occur. The importance of:

- materializations throughout processes to actually make it possible for the participants to act, experience and negotiate,
- placing the design proposals/prototypes in the world, throughout the design work is a key activity,
- understanding the designerly core competencies in intersections with relatively new competence areas, and thus meeting other assumptions about what design is, and
- the strong, but not unproblematic, power inherent in design to initiate change.

Four orders of design

It has been 25 years since Buchanan first proposed that design activity can be seen as being directed towards four orders. This is a useful framework for reflecting on aspects of where design acts (1992, 2001, 2015).

The four orders of design according to Buchanan (1992: 9-10)

1. the design of symbolic and visual communications - signs
2. the design of material objects - things
3. the design of activities and organized services - action
4. the design of complex systems or environments for living, working, playing, and learning - thought

These orders should not be interpreted as a list of professions but “[p]roperly understood and used, they are also places of invention shared by all designers, places where one discovers the dimensions of design thinking by a reconsideration of problems and solutions” (ibid. : 10). This means that when dealing with complex systems or environments for living, working, playing, and learning (i.e. the fourth order) these need to be constituted by signs, things and actions. It is therefore not possible to work with the fourth order without also dealing with the first, second and third. Design of complex systems must at the same time deal with all four orders identified by Buchanan.

Lucy Suchman also acknowledges this understanding and emphasises the need to rethink our understanding of design from that of “discrete devices” to that of systems or “networks of working relations”(2003: 2). If we also take into consideration that *system* is a metaphor for entanglements over time and space of humans and non-humans that actually are *unbounded* (Law 2014) it obviously makes proposals that also consider the fourth order immensely difficult, or even wickedly difficult.

Problem-setting, co-evolution of problem and proposal

Already in the 1960s Horst Rittel coined the concept *wicked problems* after having realised that a linear step-by-step design process cannot provide relevant solutions when the situation at hand is complex. Although treating problem definition and problem solution as separate activities, and working with them separately, may seem attractive, this cannot at all work for several reasons. (Rittel & Webber 1973, Buchanan 1992, Lawson 2004). The most obvious is that there “is no definitive formulation of a wicked problem” (Rittel & Webber 1973: 161). Wicked problems are a “class of social system problems which are ill-formulated, where the information is confusing, where there are many clients and decision makers with conflicting values, and where the ramifications in the whole system are thoroughly confusing” (Churchman 1967:141).

In their seminal paper from 1973 Rittel and Webber note that there

“are at least ten distinguishing properties of planning-type problems, i.e. wicked ones, that planners had better be alert to and which we shall comment upon in turn. As you will see, we are calling them “wicked” not because these properties are themselves ethically deplorable. We use the term “wicked” in a meaning akin to that of “malignant” (in contrast to “benign”) or “vicious” (like a circle) or “tricky” (like a leprechaun) or “aggressive” (like a lion, in contrast to the docility of a lamb). We do not mean to personify these properties of social systems by implying malicious intent. But then, you may agree that it becomes morally objectionable for the planner to treat a wicked problem as though it were a tame one, or to tame a wicked problem prematurely, or to refuse to recognize the inherent wickedness of social problems” (Rittel & Webber 1973: 160-161).

This is in line with problem-setting that we mentioned earlier. Since there is no stable, valid problem definition the issue to be dealt with needs to be explored and critically investigated throughout the whole process; designing proposals and understanding the problem co-evolve (Dorst & Cross 2001). These should be seen as two inseparable, intertwined activities that co-constitute each other.

Among the ten properties we find the central proposition: “[e]very wicked problem is essentially unique” (Rittel & Webber 1973:164) which hints us that designers need to be very open and sensitive when designing and conducting the process and not rely unreflectively on previous work. The sensitivity needed leads us to another issue that at first may seem complicating, but may provide an understanding that leads us forward, namely that that of *situated knowledges*.

Particular situations in messy contexts

It is only possible to experience the context/issues/system from one particular individual standpoint at a time. Thus making the particular situation explicitly important in understanding the complexities of social design engagement. Several people’s understanding can be *joined* through debates and negotiations. The quote in the beginning of this paper from Donna Haraway (1988) presents questions needed to ask when acknowledging this particularly, situated perspective on knowledge and knowledge production. When designers acknowledge these complex and messy settings, these questions (and many other ones), need to become addressed and negotiated in everyday design practice. Haraway also emphasised that we always know from somewhere, there is no God’s eye view presenting complete knowing. Lucy Suchman supports this view and emphasises that we should “shift from a view of objective knowledge ... to multiple, located, partial perspectives that find their objective character through ongoing processes of debate” (2003:2).

John Law claims “that the desire for perfection – for a world without mess or mud – needs to be held in check. The most obvious political lesson to be drawn from this is specific rather than general. ... in a wicked world general formulae will come unstuck and/or generate injustices. Instead it becomes necessary to deal with political and analytical specificities. Everything is somewhat contextual. Grand stories only reach so far” (2014: 16).

This is one understanding that needs to be absolutely central in designers’ way of working; to always be sensitive about whose perspective is taken (often temporarily) in scenarios and arguments, and to be explicit about this.

Although we need ways of knowing messy contexts, John Law argues that some activities and contexts are in such complex relations to each other that they can only be known *vaguely* (Law 2003). One designerly way of exploring and inquiring into these types of messy contexts is through various types of prototyping practices.

Prototyping

Prototyping is a fundamental design competence, which should be seen as an activity for exploring, proposing and creating knowledge. It supports the on-going development of propositions and understanding of the design space (Westerlund 2009). Prototyping can be seen in line with Blomkvist’s (2014) suggestion as any external representation of a future situation serving as a common reference point that allows stakeholders to collaborate and discuss design proposals.

In order to support this, prototyping needs to afford: *imagination* (Steen 2014) of other potential realities through *experimentation* and *exploration* (Floyd 1984), *inquiring into future use* (Gedenryd 1998), making use of and acknowledging the importance of *aesthetic experience* (Stephens and Boland 2014, Wright & McCarthy 2008,). Prototyping should also support the previously mentioned *problem-setting*, i.e. creating knowledge about *messy* contexts (Law 2003, Suchman 2003). These various prototyping processes also imply extensive debate, negotiating, decision-making, re-designing, collaborating and reflecting.

PROTOTYPING FOR THE FIRST AND SECOND ORDERS OF DESIGN

Designers have relevant training in order to deal with the design of things when considering the second order. During the education on artistic foundation students and the studio model encourages material exploration of possibilities through prototypes, crits, etc. Although placed in complex situations of use, the outcomes of first and second order design is more easily accessible for creating experiential knowledge.

The things proposed are interacted with and used in complex environments, but these have mostly been things in categories that we are used to and have prior experience of. Therefore designers have not had focus on the third and fourth orders. But when design explicitly engages in the socially complex orders we discuss here it becomes obvious that designers seldom have a first hand experience/training of acting in these often politically sensitive contexts where norms and power are important factors.

PROTOTYPING FOR THE THIRD AND ESPECIALLY THE FOURTH ORDER OF DESIGN

There are several techniques for creating prototypes for interactions and services (e.g. Kimbell 2014), but since these contexts are so immensely more complex and uncertain, all prototypes, although they do make important things present, make most aspects absent. These prototypes are often seen as *representations of whole services*, but the absent aspects are seldom considered. We instead propose that we should follow Suchman's reasoning and create understandings from engaging with multiple prototypes, each making located, partial perspectives present.

A designerly way of exploring and inquiring into messy contexts is through various types of prototyping practices, that enable and encourage relevant stakeholders to engage in *ongoing processes of debate* expressing their located, partial perspective and thereby jointly creating knowledges about relevant proposals as well as understandings of "the situation".

We have presented our understanding and position of design education on artistic foundation, as well as the relation of Buchanan's four orders of design to prototyping. The importance of acknowledging that the issues dealt with are wicked and that knowing in this mess must be situated but might still only result in a vague understanding. Now we will propose an approach that embraces this messiness and wickedness, mainly with the help of John Law's thinking.

Prototyping for approaching wicked problems in messy contexts

From the presentations above follows that some of design's core competencies need to be further developed in order to better integrate third and fourth order aspects of design. In the following we will focus primarily on designers' prototyping competence when entering the "new" fields presented previously. How can prototyping be used, what are the activities it should afford and support? How do we embrace wickedness and messiness? But we also understand that since this capacity is very powerful it is necessary to develop and secure designers' critical reflection including ethical considerations (Withcomb 2016) during the education.

Since all wicked problems are unique (Rittel & Webber 1973: 164) there can not be a best approach and we will not make any such attempt, instead we will present some approaches that can support the sensitivities we believe are needed. One of the authors' favourite quotes from Rittel and Webber's important paper is "Part of the art of dealing with wicked problems is the art of not knowing too early..." (1973: 164). This is definitely one of design's core competencies; staying with uncertainty, the trouble, and exploring alternative propositions throughout the whole design process.

Blomkvist (2014) argued that prototyping creates representations. John Law presents a very productive understanding of the concept representation in *Making a Mess with Method* acknowledging that in representations "some things ... are present but at the same time other things are being rendered absent" (2003:7). The list of things that are not made present is of course endless, some of these things are obvious and other things are made absent in order to emphasise what is made present. Law sees no problem in the "exclusion as such ... [but in] the denial of that exclusion". He calls this Othering. Othering is absence that is not acknowledged, "everything that is being repressed for one reason or another" (ibid.:8).

The prototype produces a reality that can be aesthetically experienced. It is obvious that we experience what is present, but in the messy and often politically sensitive contexts dealt with here, the issues that are absent and Othered can be crucial. We suggest that design students need to be put in situations where they may practice themselves in reflecting on what is made absent and what is Othered. This needs to be done collaboratively with other stakeholders in order to explore what is Othered, since it is almost impossible to see what you don't see.

Is it even possible to prototype in such messy, complex, social and entangled environments, environments that are unbound? How shall this be represented materially with temporal aspects? One approach can be to acknowledge that understanding must be someone's understanding from somewhere (Haraway 1988) and also that messy environments can only be known vaguely (Law 2003). This situated approach might make prototypes easier to experience and also acknowledges that there are many aspects and perspectives absent.

This addresses the messiness, in the following we explore Law's suggestions on how to work well with wickedness (2014). He argues that the only way of dealing with wicked problems is

to render them temporarily benign, and argues that this implies the need to hold together series of opposites.

“In particular it is necessary to:

- homogenise problems whilst recognising that these are essentially heterogeneous;”

Designers work with the parts/details and the whole, simultaneously as well as separately.

“• simultaneously centre and decentre problem solving;”

Above we discussed the importance of acknowledging that knowing must be from one position, from one body, one centre, while we know that by decentring we will experience a different understanding.

“• close off alternative ways of simplifying contexts whilst also being open to alternatives; and”

Designers temporarily close off alternatives by applying designer-imposed constraints (Gedenryd 1998) knowing that these can be abandoned and the proposition can be opened up for alternatives. Designers initially start off working with some approach and method that previously has worked well, but will easily switch and adapt to what seems to work better.

“• assume that particular problem framings are generally applicable whilst recognising that they are not.” (2014: 3)

It is of outmost importance to keep in mind that whatever prototypes have been made and proposals presented as suggestions for change in the messy wicked settings we deal with here, these are framed using temporarily benign approaches, and since this messiness can only be known vaguely it is morally necessary to keep reflecting on if this could be different, what is rendered absent and Othered.

Finally, when it comes to prototyping, we suggest that it is important to abandon the idea of *THE prototype* in favour of an understanding that there is a need for several prototypes in order to support “multiple, located, partial perspectives that find their objective character through ongoing processes of debate” (Suchman 2003:2). This is similar to design’s replacement of *THE user* with *stakeholders* (Krippendorff 2006) in order to account for the many effects that a product in use has.

Law uses the concept “opposites”, but we would suggest rather seeing these as aspects or temporary approaches in design work.

Pedagogical considerations

We have argued for the importance of the combination of prototyping and reflecting and that design students need to be trained in this. An important part here is that the students create thorough understandings of how knowledge can be constructed. We find that the STS related scholars mentioned here present a constructive understanding of contemporary theories, eg. feminist theory, post-humanism, ANT. These are often put to work in relations between humans and things, which are crucial for design.

Bryan Lawson argues that in order for *theory* to be available for students to make use of during design work, it needs to have been tried out, *experienced*, it needs to be experiential or episodic knowledge and not only semantic (2004). It seems as if students need to be engaged in designing in complex environments and in doing so paying attention to Buchanan's all four orders of design and also having to consciously reflect on what is rendered absent and what might be Othered. And also engaging in a reflection of how well they are holding Law's series of "opposites" together. We believe that this approach must be emphasised in courses in order for students to be able to understand effects on the fourth order of design.

Example: prototyping workshops regarding urban planning

This case is taken from a project, Decode, which explores if and how co-design approaches can contribute to democratisation of official urban planning processes. The case is more thoroughly presented by Frögård (2016) and Westerlund (2016), from where a large part of the presentation is borrowed.

Two workshops were create and conducted, inspired by and exploring an on-going conflict. The conflict concerned the proposal of two new streets with through traffic between apartment buildings that have existed since the 1960's. 900 citizens had signed a petition protesting against the streets that were suggested by the municipality's planning office and supported by the politicians.

There were several arguments for and against the streets, both very abstract and concrete. The citizens were very concrete in their protests. They claimed that the traffic on the streets would be very disturbing for the people living next to them; there would be risk for accidents with pedestrians, cyclists, people with disabilities and children. To make space for the streets over 20 trees need to be chopped down.

The planners, politicians and therefore also the official documents were more abstract arguing the advantages for the area to be city-like and have a fine-mesh network of streets.

In order to explore this situation we decided to conduct two prototyping, co-design workshops (Westerlund 2009) with the aim to support a creative discussion of possible alternative proposals. We invited citizens, civil servants and politicians to the two workshops. We wanted to create an understanding of the design space, i.e. the multiplicity of possible proposals that would be accepted by enough people. We wanted the participants to stay with their experience, not strive for consensus, but still negotiate, adjust their understanding and respect the other participants experience and opinions.

The approach or method was to encourage participants to create proposals, debate these and to be very particular and precise during the workshop.

The participants created several reasonable proposals that would afford many people to continue with their current everyday activities. Image 1 presents one proposal, drawn on tracing paper on top of the quite detailed account for the workshop participants' current use of the area. One aim was to support debate between alternative design proposals co-created by the participants and the proposal made by the community's planning office.

One common-sense understanding of the workshop method would be that the proposal that afforded most activities and constrained the least would be the one implemented, but this is not what happened in this case. After the workshops, the politicians decided on a proposal that was quite similar to the initial proposal, the one that many of the citizens protested against. This could mean that the workshop method itself did not enable a relevant representation of the messiness where the most important aspects were made present. One aspect obviously Othered in the prototyping was power; the politicians have the power to actually decide on the actual design of the area, while the citizens participating in the workshop could only produce proposals.

Our reflections are that the streets and possible future activities are quite *present* in the prototype, while the democratic system was *Othered*. Further we know that there was awareness among the participants of the *absence* of both future stakeholders and young citizens in the proposals.

The effort to make the proposals and discussions concrete, and therefore not deal with more abstract values and concepts (e.g. city-like) perhaps Othered the possibility to also negotiate and reflect on some even more important issues, like power. Where there other constraints that we did not deal with in the workshop? What more is Othered? What else could hinder actualising the participants' proposals?



Image 1. This aerial photo was used to indicate, or represent, the current activities done by the participants on the area in question. Here is also one of the alternative proposals for where the street should be located, on tracing paper.

Concluding remarks

Designers' engagement or entanglement with other people and things in prototyping of policies, municipalities' services and other, may lead to propositions that have large impact on many people. Designers whose mind-set and approach works well considering the impact

in Buchanan's first and second orders, may not have the tools, mind-set or approach to create understandings of the impacts in the third and fourth orders of design. Since designers have a heavy influence on the prototyping process and may therefore have a great impact on the proposition, they need to have tools for critically reflecting that match this agency; tools to understand the effects of the proposition, to develop the prototype in such ways that intended and unintended uses and other effects can be imagined and experienced.

Contemporary design education that acknowledges that students' work will have impact on the third and fourth orders of design need to afford students to experience wicked problems and work with them in designerly ways. Students need to elaborately explore prototyping and get insights into the importance of the situated, particular, multiple, located, partial perspectives that afford on-going processes of debate.

Students also need to be supported to be able to engage with practices of reflection on prototyping. One suggested approach is to engage in joint understanding together with relevant stakeholders and reflect on what the prototypes render *present*, *absent* and what is *Othered*. Design students need to engage in these activities of prototyping and reflection in order to *experience* these debates. Thereby being able to practice these activities in future work. Students therefore need extensive practice in collaboration with relevant stakeholders, developing an ethical approach, as well as theoretical understandings of the importance of located, situated knowledges, and the particular. They need understanding of relevant theories in order to reflect on a meta-level on their activities and learnings.

In other words, there are no short cuts nor preconfigured step-by-step processes that lead to relevant propositions that effect complex social and political contexts. Instead designers and stakeholders must be engaged in extensive prototyping and reflection in collaboration in order to create relevant understanding of the current situations, stakeholders, issues, problems, opportunities, disadvantages as well as propositions.

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Acknowledgements: This paper could not have been written without the many discussions with colleagues on approaches and pedagogics in relation to design education as well as in research projects. The research is done in the project *Design beyond service and product* at Konstfack, funded by the Knowledge Foundation (KK-stiftelsen). The example from the project Decode, at Konstfack and funded by Vinnova, Sweden's innovation agency.